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TREASURY DEPARTMENT.

Public Health and Marine-Hospital Service of the United States.

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HYGIENIC LABORATORY.—BULLETIN No. 13.

M. J. ROSENAU, Director.

May, 1903.

A STATISTICAL STUDY OF THE INTESTINAL PARASITES OF 500 WHITE MALE PATIENTS AT THE UNITED STATES GOVERNMENT HOSPITAL FOR THE INSANE.

By PHILIP E. GARRISON, BRAYTON H. RANSOM,
AND EARLE C. STEVENSON.

A PARASITIC ROUNDWORM (*Agamomermis culicis* n. g., n. sp.) IN AMERICAN MOSQUITOES (*Culex sollicitans*).

By CH. WARDELL STILES.

THE TYPE SPECIES OF THE CESTODE GENUS *Hymenolepis*.

By CH. WARDELL STILES.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1903.

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The Hygienic Laboratory was established in New York, at the Marine Hospital on Staten Island, August, 1887. It was transferred to Washington, with quarters in the Butler Building, June 11, 1891, and a new laboratory building, to be located in Washington, was authorized by act of Congress, March 3, 1901.

The following *bulletins* [Bull. Nos. 1-7, 1900 to 1902, Hyg. Lab., U. S. Mar.-Hosp. Serv., Wash.] have been issued:

No. 1.—Preliminary note on the viability of the *Bacillus pestis*. By M. J. Rosenau.

No. 2.—Formalin disinfection of baggage without apparatus. By M. J. Rosenau.

No. 3.—Sulphur dioxide as a germicidal agent. By H. D. Geddings.

No. 4.—Viability of the *Bacillus pestis*. By M. J. Rosenau.

No. 5.—An investigation of a pathogenic microbe (*B. typhi murium* Danyz) applied to the destruction of rats. By M. J. Rosenau.

No. 6.—Disinfection against mosquitoes with formaldehyd and sulphur dioxide. By M. J. Rosenau.

No. 7.—Laboratory technique: Ring test for indol, by S. B. Grubbs and Edward Francis; Collodium sacs, by S. B. Grubbs and Edward Francis; Microphotography with simple apparatus, by H. B. Parker.

By act of Congress, approved July 1, 1902, the name of the "United States Marine-Hospital Service" was changed to the "Public Health and Marine-Hospital Service of the United States," and three new divisions were added to the Hygienic Laboratory.

Since the change of name of the service the bulletins of the Hygienic Laboratory have been continued in the same numerical order, as follows:

No. 8.—Laboratory course in bacteriology and pathology. By M. J. Rosenau.

No. 9.—Presence of tetanus in commercial gelatin. By John F. Anderson.

No. 10.—Report upon the prevalence and geographic distribution of hookworm disease (uncinariasis or anchylostomiasis) in the United States. By Ch. Wardell Stiles.

No. 11.—Experimental investigation of *Trypanosoma Lewisi*. By Edward Francis.

No. 12.—The bacteriological impurities of vaccine virus; an experimental study. By M. J. Rosenau.

No. 13.—A statistical study of the intestinal parasites of 500 white male patients at the United States Government Hospital for the Insane; by Philip E. Garrison, Brayton H. Ransom, and Earle C. Stevenson. A parasitic roundworm (*Agamomermis culicis* n. g., n. sp.) in American mosquitoes (*Culex sollicitans*); by Ch. Wardell Stiles. The type species of the cestode genus *Hymenolepis*; by Ch. Wardell Stiles.

In citing these bulletins, beginning with No. 8, bibliographers and authors are requested to adopt the following abbreviations: Bull. No. ——, Hyg. Lab., U. S. Pub. Health & Mar.-Hosp. Serv., Wash., pp. ——.

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United States Public Health and Marine-Hospital Service.

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A STATISTICAL STUDY OF THE INTESTINAL PARASITES OF 500 WHITE MALE PATIENTS AT THE UNITED STATES GOVERNMENT HOSPITAL FOR THE INSANE.

By Philip E. Garrison, A. B., Brayton H. Ransom, M. A., and Earle C. Stevenson, B. Sc.,

Assistants in the Division of Zoology, Hygienic Laboratory, U. S. Public Health and Marine-Hospital Service.

Summary of results.—(1) The results show 13.2 per cent of the patients examined infected with intestinal parasites. The parasites found were hookworms (*Uncinaria americana* or *Agchylostoma duodenale*[a]), whipworms (*Trichuris trichiura*), seatworms (*Oxyuris vermicularis*), Cochin-China worms (*Strongyloides stercoralis*), and eelworms (*Ascaris lumbricoides*). No evidence of infection with tapeworms, flukes, or coccidia was found. (2) Our results differ from those of most foreign investigators principally in the lower rate of infection, in the absence of tapeworms, and in the presence of hookworms and of the Cochin-China worms. (3) The results show that the percentage of infection tends to vary inversely with the age and with the duration of institutional life of the patients. (4) They also indicate that army life is conducive to parasitic infection of the intestine, and, moreover, that a high percentage of the United States soldiers returning from service in the Philippine Islands have intestinal parasites. (5) The presence of a moderate number of worms in the intestine seems to have no relation to the presence of undigested starch and meat in the dejecta or to the litmus reaction of the feces.

Introduction.—By the courtesy of Dr. A. B. Richardson, superintendent of the Government Hospital for the Insane, a microscopic examination of the feces of the patients in that institution was begun early in

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[a] It could not be ascertained with certainty in some cases, from measurement of the ova, that the hookworms belonged to the species *Uncinaria americana*, as the number of the eggs was small and their size somewhat varying. In the great majority of infections, however, the eggs were found to be full 64 by 40 μ or larger, and we would have little hesitation in calling them *Uncinaria americana* rather than *Agchylostoma duodenale* in every case, were it not for the fact that most of the patients had been in the Philippines, where the Old World form (*Agchylostoma duodenale*) has been found. Final judgment as to the species of the hookworms must be reserved, therefore, until the adult worms can be obtained and examined.

September, 1902, by the Division of Zoology of the Hygienic Laboratory under the direction of Dr. Ch. Wardell Stiles, chief of the Division. The examinations were for the purpose of determining the percentage of intestinal infections with animal parasites and of demonstrating the value of microscopic examination of the feces in general clinical diagnosis. The following results have been obtained from 500 white male patients, and include the number and kinds of infection found with regard to age, length of residence of the patients within the institution, and character of life previous to admission, together with an investigation of the effects of parasitic infection of the intestine upon digestion and upon the litmus reaction of the feces.

FREQUENCY OF INFECTION.—Of the 500 patients examined, 66 patients, or 13.2 per cent, showed parasitic infection of the intestines. Ten patients had a double infection, and in one case three different parasites were present, making a total of 78 infections. These were distributed among five parasites, as follows:

PARASITES PRESENT.—

Uncinaria americana or *Agchylostoma duodenale*[a] (hookworms), 15 cases, or 3 per cent of the cases examined.

Trichuris trichiura (whipworms), 54 cases, or 10.8 per cent.

Oxyuris vermicularis (seatworms), 4 cases, or 0.8 per cent.

Strongyloides stercoralis (Cochin-China worms), 3 cases, or 0.6 per cent.

Ascaris lumbricoides (eelworms), 2 cases, or 0.4 per cent.

No evidence of parasitic infection of the liver, stomach, lungs, or other organs was present. No tapeworms, flukes, or coccidia were found.

SEVERITY OF INFECTIONS.—In general it may be said that the cases of infection with intestinal parasites found by us at the Government Hospital were not severe. In one or two cases of hookworm disease several eggs were present under a single cover-glass, but in the majority of cases we found only 5 or 6 eggs under the 10 covers examined, and in no case were the ova so numerous as in the severe infections with this parasite found by Dr. Stiles in the Southern States.[b] In some cases of infection with *Trichuris* the eggs were very numerous in the feces and indicated the presence of a great number of worms in the intestine, but as a rule not more than 5 or 6 eggs were found in examining 10 preparations. In one of the infections with *Strongyloides* the feces were rather heavily infested with the embryos. The number of eggs found in the infections with *Oxyuris* and *Ascaris* was small.

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[a] See footnote page 5.

[b] Report upon the prevalence and geographic distribution of hookworm disease (uncinariasis or anchylostomiasis) in the United States, by Ch. Wardell Stiles, Ph. D., Bull. 10, Hyg. Lab., U. S. Pub. Health & Mar.-Hosp. Serv., Wash., pp. 1-121, figs. 1-86.

The thorough and repeated treatment with purgatives which the patients at the Government Hospital receive may explain the comparatively small number of worms which seem to be present in the infected cases, for in all probability many of the worms are eliminated by repeated purgation.

COMPARISON WITH FOREIGN STATISTICS.—We have at present no American statistics of parasitic infection in adults with which to compare these general results. Following (Table 1) are the tabulated results of similar investigations in Europe and Asia, together with those obtained from the work at the Government Hospital.

TABLE 1.—*Statistics of intestinal worms, in United States, Europe, and India.*

Authority and locality.	Number of subjects examined.	Hookworms.		*Trichuris.*		*Oxyuris.*	
		Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
United States Government Hospital, 1902	500	15	3	54	10.8	4	0.8
Heisig, Germany, 1893	230	......	......	104	45.2	......	......
Cima, Italy, 1893, 1896	73	......	......	28	38.35	3	4.1
Dobson, India, 1893[a]	1,249	944	75.58	55	4.41	192	15.37
Kesler, St. Petersburg, 1888	600	......	......	30	5	43	7.16
Sievers, Germany, 1887	2,629	......	......	521	19.8	326	12.4
Roth, Germany, 1877–1880[b]	752	......	......	178	23.67	......	......
Gribbohm, Germany, 1872–1877[b]	972	......	......	313	32.20	226	23.24
Heller, Kiel, 1872–1875	611	......	......	187	30.6	142	23.2
Müller, Germany, 1862–1873[b]	1,755	......	......	159	9.05	213	12.13
Müller, Germany, 1852–1862[b]	1,939	......	......	50	2.57	43	2.21
Zaeslein, Germany[c]	......	......	......	......	23.7	......	20
Banik, Germany[c]	......	......	......	......	8.3	......	30.6

	Strongyloides.		*Ascaris lumbricoides.*		*Tænia.*		Total.[d]	
	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.	Number.	Per cent.
United States Government Hospital, 1902	3	0.6	2	0.4	......	......	78	15.6
Heisig, Germany, 1893	......	......	34	14.7	2	0.87	140	60.77
Cima, Italy, 1893, 1896	......	......	22	30.13	5	6.84	58	79.42
Dobson, India, 1893[a]	......	......	131	10.49	18	1.44	1,340	107.29
Kesler, St. Petersburg, 1888	......	......	35	5.83	......	14.51	......	......
Sievers, Germany, 1887	......	......	436	16.56	8	.30	1,291	49.06
Roth, Germany, 1877–1880[b]	......	......	86	11.43	......	......	264	35.1
Gribbohm, Germany, 1872–1877[b]	......	......	178	18.30	......	......	717	73.76
Heller, Kiel, 1872–1875	......	......	108	17.73	......	......	437	71.17
Müller, Germany, 1862–1873[b]	......	......	227	12.93	......	......	599	34.11
Müller, Germany, 1852–1862[b]	......	......	180	9.28	......	......	273	14.07
Zaeslein, Germany[c]	......	......	......	11.4	......	......	......	......
Banik, Germany[c]	......	......	......	7.3	......	......	......	......

[a] Dobson found also 13 cases of distomatosis (1.04 per cent).

[b] Heisig, 1893, Beitrag zur Statistik menschlicher Entozoen, Greifswald.

[c] Sievers, 1887, Schmarotzer-Statistik aus den Sections-Befunden des pathologischen Instituts zu Kiel.

[d] It will be noted that the figures in the total column represent the number of infections found per 100 cases, not the number of cases infected.

In every case but one the foreign results show a higher percentage of infection with all parasites than was found in our examinations. In no case was mention made of *Strongyloides*, and the only statistics for hookworms are those of Dobson in India, who found there 75.58 per cent of infection with *Agchylostoma duodenale* in examining over 1,200 natives.

Age.—The average age of the men in whom parasites were found was 37.75 years; of the uninfected cases, 47.9 years. The average age of those infected with hookworms was 32.8 years; with *Trichuris*, 36.1 years; with *Oxyuris*, 66 years; with *Strongyloides*, 45.66 years; with *Ascaris*, 41.5 years.

Dividing the patients into classes according to age, we obtain the following results:

Table 2.—*Frequency of infection with regard to age of patients.*

Age (years).	Number examined.	Hookworms.		*Trichuris.*		*Oxyuris.*		*Strongyloides.*		*Ascaris lumbricoides.*		Total.[a]	
		No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.
18–30	93	7	7.53	17	18.28	0	0	0	0	0	0	24	25.8
31–50	184	4	2.17	26	14.13	0	0	2	1.09	2	1.09	34	18.42
51 +	194	1	0.52	5	2.53	4	2.01	1	0.52	0	0	11	5.67
Unknown	29	3	10.34	6	20.69	0	0	0	0	0	0	9	31.03
Total	500	15	3.00	54	10.8	4	0.8	3	0.6	2	0.4	78	15.6

[a] See footnote *d*, table 1.

The rate of infection decreases as the age of the patients increases. Heisig found similar results in Germany, though his percentages were higher and his patients included both men and women.

Table 3.

	15 (18)–30 years.			31–50 years.			51+ years.		
	Number examined.	Infected.		Number examined.	Infected.		Number examined.	Infected.	
		No.	Per cent.		No.	Per cent.		No.	Per cent.
Heisig	17	7	41.5	28	9	32.1	23	3	13.
Government hospital.	93	24	25.8	184	33	17.9	194	11	5.67

Length of residence in the hospital.—Considering the amount of infection found with regard to the length of residence of the patients within the hospital, the results are as follows: Admitted within one year, 162 men; infected, 28 men, or 17.28 per cent. With from one to three years' residence, 154 men; infected, 20, or 12.99 per cent. From three to eight years, 57 men; infected, 5, or 8.77 per cent. From eight to fifteen years, 45 men; infected, 3, or 6.66 per cent. More than fifteen years, 71 men; infected, 7, or 9.86 per cent.

The rate of infection decreases as the length of residence in the hospital increases, except in the class which had spent fifteen years or more in the institution, where the percentage rises.

The following table gives the frequency of infection with each parasite in each of the above classes:

TABLE 4.—*Frequency of infection with regard to length of residence in the hospital.*

Number of years.	Number examined.	Hookworms.		*Trichuris.*		*Oxyuris.*		*Strongyloides.*		*Ascaris lumbricoides.*		Total.[a]	
		No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.
–1	162	9	5.5	26	16.09	0	0	0	0	1	0.62	36	22.22
1–3	154	4	2.57	18	11.69	0	0	3	1.95	0	0	25	16.23
4–8	57	1	1.75	5	8.77	0	0	0	0	1	1.75	7	12.28
9–15	45	1	2.22	1	2.22	1	2.22	0	0	0	0	3	6.66
15+	71	0	0	4	5.63	3	4.23	0	0	0	0	7	9.86
No record	11	0	0	0	0	0	0	0	0	0	0	0	0
Total	500	15	3.00	54	10.8	4	0.8	3	0.6	2	0.4	78	15.6

[a] See footnote [d], table 1.

CHARACTER OF LIFE PREVIOUS TO ADMISSION.—Considering the patients examined with regard to the character and conditions of their life immediately previous to admission to the hospital, they fall into four main groups—those admitted from the Army, those admitted from the United States Soldiers' Homes, those admitted from the District of Columbia, and those admitted from the Navy. A fifth or miscellaneous class contains a small number of United States convicts, patients admitted from the United States Territories, and a few men concerning whose previous life no data were obtainable. The Army group is naturally subdivided into three classes: First, men admitted before the outbreak of the Spanish-American war (1898), composed of soldiers from the regular army posts; second, soldiers engaged in that war who served within the States; and, a third and important class, soldiers who had returned from service in the Philippine Islands.[a]

Soldiers admitted before 1898.—This class included 30 men, 4 of whom, or 10 per cent, had intestinal parasites. Three infections were with *Trichuris trichiura* and 1 with *Oxyuris vermicularis.*

Soldiers admitted after 1898.—This class also contained 40 men, 9 of whom, or 22.5 per cent, were infected with parasites. Eight infections were with *Trichuris trichiura* and 1 with hookworms.

Soldiers returned from the Philippines.—Fifty-nine men were examined who had returned from service in the Philippines. Twenty-five of these, or 42.46 per cent, had intestinal parasites. Fifteen men were infected with *Trichuris* alone, 1 with hookworms alone, 7 with hookworms and *Trichuris*, 1 with hookworms and *Strongyloides*, and 1 with hookworms, *Trichuris*, and *Ascaris.* Thus in the 59 soldiers there were 10 infections with hookworms, 23 infections with *Trichuris*, 1 infection with *Strongyloides*, and 1 infection with *Ascaris*, or a total of 35 infections.

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[a] Of the soldiers admitted to the Government hospital after service in Cuba and Porto Rico nearly all had been discharged before these investigations were begun, so that the interesting statistics which might be expected from this class were not obtainable.

Men admitted from the United States Soldiers' Homes.—Of the 124 men admitted from the United States Soldiers' Homes 8 men, or 6.45 per cent, were infected. Hookworms, *Oxyuris*, *Strongyloides*, and *Ascaris* were each found once, while *Trichuris* was present four times.

Men admitted from the District of Columbia.—This class included 137 men, 11 of whom, or 8.03 per cent, were infected, namely, 9 with *Trichuris*, 1 with *Oxyuris*, and 1 with *Strongyloides*.

Men admitted from the Navy.—Forty-two patients were admitted from the Navy or from naval hospitals. Of this number 4 men, or 9.5 per cent, had intestinal parasites. Hookworms were found once and *Trichuris* was found three times.

Miscellaneous.—Of the 58 patients not classified, 7 men, or 12.07 per cent, showed infection, namely, 2 with hookworms, 4 with *Trichuris*, and 1 with *Oxyuris*.

These results are summarized in the following table:

TABLE 5.—*Frequency of infection with regard to character of life previous to admission to the hospital.*

Previous history.	No. examined.	Hookworms.		*Trichuris.*		*Oxyuris.*		*Strongyloides.*		*Ascaris lumbricoides.*		Total.[a]	
		No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.
Army before 1898	40	0	0	3	7.5	1	2.5	0	0	0	0	4	10.0
Army after 1898	40	1	2.5	8	20.0	0	0	0	0	0	0	9	22.5
Philippine Islands	59	10	16.95	23	38.98	0	0	1	1.7	1	1.7	35	59.32
Soldiers' Homes	124	1	0.81	4	3.23	1	0.81	1	0.81	1	0.81	8	6.45
District of Columbia	137	0	0	9	6.57	1	0.73	1	0.73	0	0	11	8.03
Navy	42	1	2.38	3	7.14	0	0	0	0	0	0	4	9.52
Others	58	2	3.47	4	6.9	1	1.72	0	0	0	0	7	12.09
Total	500	15	3.00	54	10.8	4	0.8	3	0.6	2	0.4	78	15.6

[a] See footnote *d*, Table 1.

THE SIGNIFICANCE OF AGE, INSTITUTIONAL LIFE, AND THE CONDITIONS OF PREVIOUS LIFE WITH REGARD TO THE AMOUNT OF INFECTION WITH INTESTINAL PARASITES.—The soldiers admitted after service in the Philippine Islands, among whom was found a percentage of infection more than twice as high as in any other class, were for the most part young men, their average age being 30.5 years. They were also patients of recent admission, none having been in the hospital longer than three years. We may discover the relative significance of Philippine service as a condition favorable to infection with intestinal parasites by comparing the Philippine men with that class of patients who during the late war served in the reserve camps situated principally in the Southern States. The average age of this latter class of men was 34.8 years, and all but four had been admitted to the hospital within three years, thus presenting conditions about the same as found among the Philippine men. The frequency of infection, however, was only 20 per cent, as compared with 42.46 per cent among the soldiers returned from the Philippine Islands. The much higher rate of infection in the Philippine men can be accounted for by the greater prevalence of the parasites in the Philippines and by the poor sanitary conditions under which it was necessary for the men to live during active service in the islands.

The results obtained in these examinations at the Government hospital would indicate that a large number of the United States soldiers returning from service in the Philippine Islands return with a parasitic infection of the intestines. While the percentage of infection with hookworms (16.95 per cent) among these soldiers was not so high as that with whipworms (39.98 per cent), its clinical importance is much greater, because of the severe anemic and nervous symptoms which the hookworm is capable of producing; and the danger of this parasite being spread in this country, especially the danger of its being carried to parts of the country where it does not now exist, makes the presence of hookworm infection among the soldiers returning from the Philippines a matter of moment from the view-point of public health.[a]

The patients admitted from the Army after the outbreak of the Spanish-American war show a much higher rate of infection (20 per cent) than do those admitted from the Regular Army before 1898 (10 per cent). In the former class we find an average age of 34.8 years and only four men who had been in the hospital longer than three years. In the latter class the average age was 45.6 years, and all except six of the men had been in the hospital longer than eight years. Accordingly, the lower percentage of infection among the soldiers admitted before the war seems to be due to a combination of three factors, namely, greater age, longer period of institutional life, and the better sanitary and hygienic conditions found at the Regular Army posts than in the temporary reserve camps established during the war.

Considering the 124 patients who had been admitted to the Government hospital from the United States Soldiers' Homes, we find the highest average age (62.9 years) of any of the classes studied, and while 97 of the 124 men had been received at the hospital within three years prior to our examination, all of them had resided for a longer or shorter period at the Soldiers' Homes, so that we have a combination of old age and a long period of institutional life. In this class we found the lowest rate of infection (6.45 per cent).

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[a] Since this report was prepared the feces of 9 soldiers newly arrived at the Government hospital from the Philippines have been examined for parasites. Six of the 9 men were infected, 1 with hookworms alone, 1 with hookworms and *Trichuris*, 2 with *Trichuris* alone, 1 with *Ascaris lumbricoides* alone, and 1 with *Ascaris lumbricoides* and *Trichuris*.

The 137 civilians admitted to the hospital from the District of Columbia were rather evenly distributed both with regard to age and to length of residence in the institution. Their average age was 42.5 years. Seventy-four men had been admitted within four years, and 59 had had longer than four years' residence in the hospital. Of the 137 men 8.03 per cent were found infected. The 74 patients who had been admitted within four years showed 9.46 per cent of infection, while the 59 patients with a longer residence showed only 6.78 per cent.

These results are lower than those obtained by Sommer in the District of Columbia in 1895. (Southern Journal of Homœopathy, December, 1895, pp. 353–354.) In examining 36 children, ranging from 1 month to 14 years in age, in the Children's Hospital of the District, he found 11.11 per cent to have intestinal parasites. All the infections were with *Trichuris*. The difference in age and in condition between his patients and those examined at the Government hospital may well explain the disparity in results.

In the 42 patients admitted from the United States Navy we find again a younger class of men, averaging 34.6 years, and men of comparatively recent admission to the hospital, 25 of the 42 having been received within three years prior to our examination. Although the average age and the average length of institutional life are lower in this class than in the soldiers admitted from the Regular Army, the percentage of infection is lower, for which we must hold accountable the conditions of their life prior to admission.

DIGESTION.—In the investigation of the relation of parasitic infection of the intestines to the presence of undigested food in the feces our results were entirely negative. In 28 cases large quantities of undigested starch granules were found in the stools and in 7 cases a large quantity of undigested meat fibers. Of these 35 cases only 6 were infected with parasites. On the other hand there were 61 men with parasites present in the intestine who did not show this evidence of poor digestion of starch or meat.

LITMUS REACTION OF FECES.—The litmus test was made of the feces of 324 patients. Of the 270 uninfected cases tested 79.26 per cent were alkaline, 15.93 per cent acid, and 4.81 per cent gave no reaction. Of 54 cases tested where parasites were present 81.48 per cent were alkaline, 12.77 per cent acid, and 5.55 per cent gave no reaction. About the same results were obtained by considering the infections with each parasite separately, alkaline and acid reaction being present in practically the same proportions as in the uninfected feces. The results, therefore, must be considered as entirely negative.

TECHNIQUE.—Some difficulty was anticipated in obtaining the fecal specimens and in conveying them from the hospital into the city to the laboratory, where the examinations were to be made, but as the work progressed the following methods were developed and very little trouble was experienced:

The attendants on the wards were provided with aluminum chambers into which the stools were passed in the morning before or immediately after breakfast, when the patients generally desire to defecate. The stubbornness and the suspicious ideas of the patients in many cases were difficult to overcome, but there were very few cases where by patience and persistence on the part of the attendants the specimen could not be obtained. The chambers containing the feces were set aside in a vacant room by the attendants.

From one to two grams was taken from each specimen (preferably from the surface) and wrapped in a piece of common wrapping paper. These papers being thoroughly wrapped together in a large piece of paper made a small package which could be carried handily and without odor. In case the excrement were fluid, small glass jars with screw tops were used. To transfer the specimen to the paper or jar we made use of 1 by 3 inch glass slides, which were cleanly and could be readily washed and reused, or of stiff cardboard slips.

Ten preparations were made from each specimen for examination with the microscope, using the following technique: The large 2 by 3 inch glass slides were used, these being cleaner and more easily handled than the ordinary 1 by 3 inch slide. A drop of distilled water was placed on each slide, and with this a portion of the feces little larger than a pin head was thoroughly mixed by rubbing with the end of a glass rod. On this preparation was placed a three-quarter inch cover glass (square preferred) of medium thickness. Two preparations were made on each slide and then examined with the microscope while fresh without staining, using a lens of moderate power, such as the Zeiss 8 mm. or the Zeiss C. To insure greater accuracy at least two men examined preparations from each specimen. The examination of ten specimens (100 preparations) is an average day's work for one person.

A PARASITIC ROUNDWORM (AGAMOMERMIS CULICIS N. G., N. SP.) IN AMERICAN MOSQUITOES (CULEX SOLLICITANS).

By Ch. Wardell Stiles, Ph. D.
Chief of Division of Zoology, Hygienic Laboratory, United States Public Health and Marine-Hospital Service.

At a time when mosquitoes are subjected to such careful study, because of the important relations they bear to public health, especially in connection with malaria, yellow fever, etc., it is of interest to determine what parasites naturally infest them. This determination has its practical as well as its scientific value, for it enables us to eliminate certain nonpathogenic parasitic organisms from the life cycle of pathogenic organisms, stages of which may be found in mosquitoes. It further has its direct practical bearing in that the parasites of mosquitoes may multiply to such an extent as to become important factors in killing the insects, or at least in rendering them less fertile.

Quite recently several parasites have been described for the Culicidæ. Ross (1895) has found intestinal gregarines in mosquito larvæ in India. Perroncito (1899) has found a filamentous phytoparasite in *Anopheles* collected near Turin, Italy. Laveran (1902) has described a pathogenic yeast in the abdominal cavity of *Anopheles maculipennis* collected in Spain, and he reports various acarines as external parasites of the Culicidæ. Léger (1902) has described a parasitic flagellate (*Crithidia fasciculata*) in the intestine of the adult female of *Anopheles maculipennis*. Herbert Johnson (1902) has described a sporozoon as infecting about 8 per cent of the females of *Anopheles maculipennis* collected in a certain locality in Massachusetts in which tertian malaria is endemic. Martirano (1901) has described a minute trematode (*Agamodistomum Martiranoi*[a] Stiles, 1903 [new name]) found in the body cavity of *Anopheles claviger* (=*A. maculipennis*) taken in Italy. G. W. Mueller found an undetermined sporozoon of the genus *Glugea* in *Culex*.

To these cases of parasitism I am now able to add another of considerable interest. Prof. John B. Smith, of Rutgers College, has kindly forwarded to me for examination two worms taken from the abdominal cavity of *Culex sollicitans*. One specimen was hardly in condition to be of use in study, but it represented a larval roundworm, probably either a *Mermis* or a *Paramermis*. The second specimen was determined as a larval roundworm, but owing to the fact that its genital organs were not developed, its exact generic position could not be recognized. It apparently belongs in the family Mermithidæ, either to *Mermis* or to *Paramermis*. It will be convenient to recognize for these larval forms a special biological group, for which I propose the name *Agamomermis*.

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[a] Martirano, 1901, Centralbl. f. Bakteriol., Parasitenk. [etc.], Jena, v. 30 (23), 24. Dec., pp. 849–852, figs. 1–4.

The characters of the groups in question may be summarized as follows:

Family MERMITHIDÆ.

Family diagnosis.—Thread-like worms, quite similar to *Filaria* in general appearance. Mouth with 6 papillæ. In adults, the posterior end of the intestinal canal is more or less atrophied. Male with 1 or 2 spicules and with numerous caudal papillæ aranged in three or four rows. Larvæ parasitic, especially in the abdominal cavity of arthropods; adults free living.

Type genus.—*Mermis* Dujardin, 1842.

Genus MERMIS Dujardin, 1842.

Generic diagnosis.—Mermithidæ: Male with two equal spicules.

Type species.—*Mermis nigrescens* Dujardin, 1842.

Genus PARAMERMIS von Linstow, 1898.

Generic diagnosis.—Mermithidæ: Male with one spicule.

Type species.—Not determined—either *P. crassa* (von Linstow, 1889) or *P. aquatilis* (Dujardin, 1845).

Group AGAMOMERMIS Stiles, 1903.

Generic diagnosis.—Mermithidæ: An artificial collective group containing larval forms which can not be more definitely determined because of lack of genital organs. As such a group is artificial it should have no type species.

Species AGAMOMERMIS CULICIS Stiles, 1903.

Specific diagnosis.—*Agamomermis:* About 11 mm. long; 240 μ in diameter. Caudal spine 88 μ long.

Habitat.—Abdominal cavity of mosquitoes (*Culex sollicitans*), New Jersey.

Type specimen.—Collection U. S. P. H. & M.-H. S., No. 9401,[a] in poor condition; collected by Dr. John B. Smith, New Brunswick, N. J.

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[a] Important notice to helminthologists.—In order to prevent confusion, and following the precedent of the United States Bureau of Animal Industry, the specimens of parasites and of other objects in medical zoology which become property of the Division of Zoology, Hygienic Laboratory, United States Public Health and Marine-Hospital Service, will be given numbers in the series of the Helminthological Collection of the United States National Museum.

Nos. 1 to 4700 have been set aside for the United States Bureau of Animal Industry.

Nos. 4701 to 9400 have been set aside for the miscellaneous specimens of parasites deposited in or presented to the United States National Museum or sent to the Museum for determination.

Nos. 9401 to —— have been set aside for the United States Public Health and Marine-Hospital Service.

In the summer of 1889 I collected a number of specimens of *Agamomermis sp.* from mosquitoes of the species *Culex nemoralis* taken in the vicinity of Leipzig, Saxony. Whether they were identical with the present form I am unable to state. The interesting fact may be mentioned, however, that the Leipzig *Agamomermis* was decidedly injurious to the mosquitoes. It was found in the abdominal cavity of larvæ, pupæ, and adults, so that infection must have taken place in the water, namely, in the larval and pupal stages of the *Culex*. The infested insects were very sluggish in their movements and could usually be easily recognized as diseased. Many of them died from the effects of the parasite, and the ovaries of infected females were underdeveloped. Professor Leuckart informed me at that time that he had frequently found *Culex nemoralis* infected with this worm, and that during the years that the worms were most common the mosquitoes seemed to be less numerous.

These cases represent interesting instances in nature, where a pest is subject to other pests which tend to hold the former in check.

At least two other species of *Mermis* should be placed in the collective group *Agamomermis*, namely, *Agamomermis gammari* (von Linstow, 1892), parasitic in *Gammarus pulex*, and *A. sialidis* (von Linstow, 1892), parasitic in *Sialis lutaria*.

Bibliography.—Bibliographic citations follow the references in Stiles & Hassall, Index-Catalogue of Medical and Veterinary Zoology, Bull. 39, Bureau Animal Industry, U. S. Dept. Agric., Wash.

THE TYPE SPECIES OF THE CESTODE GENUS HYMENOLEPIS.

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The determination of type species for certain genera is not unattended with difficulties and with differences of opinion. *Hymenolepis*, for example, presents an instance in regard to which helminthologists are not in accord. The premises of the case are these:

(1) Weinland (1858, § 68, pp. 49 to 57) proposed the genus *Hymenolepis*. (2) He did not specifically state that any particular species was chosen as a type; (3) but he combined only one specific name, namely, *flavopunctata* (=*Tænia diminuta*), with *Hymenolepis* (see Weinland, 1858, pp. x, 16, 49, 52, 53, 55, 57, 58, 75, 85, 92). (4) His discussion of the genus is based on this form. (5) In a footnote, pp. 50 to 53, to this discussion, he reviews the classification of certain tapeworms and, p. 52, he mentions *Hymenolepis*. (6) This genus he there divides into two subgenera, namely, (7) Subgenus 1. *Lepidotrias*, stating "As the type, we may consider *Tænia murina* Dujardin; and besides this belong here *Tænia scalaris*, - - - -, and *Hymenolepis flavopunctata*." (8) Subgenus 2. *Dilepis* - - - - - - "and we may consider *Tænia angulata* Rudolphi as its type." (9) In *Dilepis* he also placed, besides other species, "the Tænioid of the golden-winged woodpecker, mentioned above, § 28." (10) The latter form is evidently *Liga punctata*, described in 1857 as new species from *Picus auratus* (=the flicker, *Colaptes auratus* (Linnæus, 1758), Vigors, 1827), as is seen from the description of the testicles. (11) *Liga punctata* is type and only species of *Liga* Weinland, 1857.

In this case, therefore, at the date of 1858 we have four generic names (*Hymenolepis*, 1858; *Lepidotrias*, 1858; *Dilepis*, 1858; and *Liga*, 1857) to deal with, and of these Weinland should undoubtedly have used *Liga* instead of proposing *Hymenolepis*.

Types were definitely fixed for *Lepidotrias*, namely, *Tænia murina* Dujardin, 1845 (not Gmelin, 1789)=*Tænia nana* von Siebold, 1852, which is also type of *Diplacanthus* Weinland, 1858 (not Agassiz, 1842); for *Dilepis*, namely, *T. angulata;* and for *Liga*, namely, *L. punctata.*

As the subgenus *Dilepis*, 1858, contained the older genus *Liga*, 1857, Weinland should not have proposed *Dilepis;* but since he definitely proposed *T. angulata* as type, the case comes under § 7 of the Stricklandian code, which states: "Provided, however, that if these authors select their respective types from different sections of the genus, and these sections be afterward raised into separate genera, then these names may be retained in a restricted sense for the new genera, respectively." Thus as long as *Liga* and *Dilepis* are considered generically or subgenerically identical, *Liga*, 1857, takes precedence over *Dilepis*, 1858; but if *Liga* and *Dilepis* are recognized as generically distinct, both names are available (but not necessarily valid) for the respective genera or subgenera.

In determining the type of *Hymenolepis* we have before us a case of practically the same nature. Weinland has definitely designated *Tænia murina* as type of *Lepidotrias*, but he has placed *Hymenolepis flavopunctata* in this subgenus. The genus *Hymenolepis* itself is based directly upon *flavopunctata*, as is clearly shown by the reference, "Gen. 1. *Hymenolepis* Weinland (see § 68)," for § 68 is the discussion of *H. flavopunctata*, and this reference "(see § 68)" can, and I believe it should, be interpreted as designation of the type. Thus, if *Hymenolepis flavopunctata* (=*T. diminuta*) and *Tænia murina* (=*T. nana*) are congeneric, *Lepidotrias* is synonym of *Hymenolepis;* but should these two species ever be recognized as generically distinct, both names are available in determining the valid names of the respective genera.

In 1896 I published *flavopunctata=diminuta* as type of *Hymenolepis*, basing my action on the above interpretation, but not publishing the details.

At that time the fact had escaped my attention that Blanchard (1891a) had mentioned *T. murina=T. nana* as type. Blanchard's reasoning was apparently based on the view that *Hymenolepis* had been divided into two subgenera, both of the latter having type species; hence either *murina* or *angulata* should be type of *Hymenolepis.*

There is a certain amount of justice in this point of view, and it must be admitted that one of Weinland's (1861, pp. 1–24) papers lends considerable support to it. Still this interpretation does not appear to correspond altogether with Weinland's earlier publications or intentions. In chronological sequence Weinland's text (§ 68) was surely written before his footnote. The fact that he consistently combined *flavopunctata*, but no other species, with *Hymenolepis* is significant. Further, if *flavopunctata* is taken as type of *Hymenolepis*, the name *Lepidotrias* is not hopelessly suppressed, while if *murina=nana* is taken as type of *Hymenolepis* we needlessly forfeit all use of *Lepidotrias* unless *Hymenolepis* should eventually prove to be a homonym.

In order to obtain the views of other zoologists who have made a special study of the principles involved in determining type species, I have laid this case, with the original literature in question, before Drs. Merriam and Palmer (mammalogists and ornithologists), Dr. Stejneger (ornithologist and herpetologist), Dr. Gill (ichthyologist), Dr. Dall, (conchologist), and Dr. Benedict and Miss Rathbun (both of whom have given especial attention to the types of crustacea). Of these 7 specialists, none of whom knew which position Blanchard supported and which one I adopted, Dr. Palmer inclined to the view that *murina* (= *nana*) should be the type of *Hymenolepis*; Dr. Benedict thought that it might be either *murina* or *flavopunctata*, and all the other 5 thought that no question could be raised since it seemed so evident that Weinland himself looked upon *flavopunctata* as type of *Hymenolepis*.

Braun (1900a, pp. 1669, 1717) accepts *Tænia diminuta* as type of *Hymenolepis*, thus adopting the ruling I made in 1896.

Bibliography.—Bibliographic citations follow the references in Stiles & Hassall, Index-Catalogue of Medical and Veterinary Zoology, Bull. 39, Bureau Animal Industry, U. S. Dept. Agric., Wash.

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